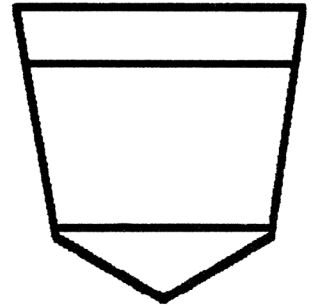


POCKET COMPUTER NEWSLETTER



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Issue 42 - September/October

Photo *The New Sharp PC-2500 Portable Notebook Computer.*



Another *Personal Information*  product.

SHARP ANNOUNCES PC-2500 PORTABLE NOTEBOOK COMPUTER

Sharp Electronics Corporation has officially introduced a new portable notebook computer dubbed the model PC-2500.

The unit measures approximately 11-3/4 x 8-1/4 x 1-3/4 inches. It sports a full-sized typewriter-style keyboard, augmented by eight special function keys. A liquid-crystal display provides four lines of 24 characters per line or a graphics mode containing 150 x 32 pixels. There is also a built-in printer/plotter that can produce text and graphics in four colors. Its weight is under three pounds.

The PC-2500 is said to contain ROM software enabling it to be programmed in BASIC. It also is reported to contain two applications programs: a spreadsheet-style "business" package and a database-style "phone" directory.

Rechargeable nickel-cadmium batteries are said to be capable of supplying the unit for up to 100 hours at a time. Additionally, a built-in serial input/output port enables the unit to be connected to other computers, a printer, or external modem.

The PC-2500 comes equipped with 5 kilobytes of user RAM. This can be expanded to a total of 13 kilobytes or 21 kilobytes by installing optional 8K (CE-201M) or 16K (CE-202M) memory expansion cards. These battery-backed memory modules are said to be easily inserted or removed from a slot in the side of the computer.

The PC-2500 may prove to be of special interest to value added retailers and software vendors. This is because custom software applications can be provided on the CE-201M and CE-202M memory expansion cards. Additionally, since the PC-2500 apparently utilizes the same CPU as the pocket model PC-1350, the PC-2500 may be capable of serving as a more convenient development station for PC-1350 applications.

The price of the new computer in the United States of America is said to be pegged at \$395.00. For further information contact: Sharp Electronics Corporation, Systems Division, 10 Sharp Plaza, Paramus, NJ 07652.

MEMORY EXPANSION MODULES FOR THE HP-71B

Want a lot more RAM in your HP-71B? Contact: *Hand Held Products, Inc., P.O. Box 2388, Charlotte, NC 28211.* (Telephone (704) 541-1380.) They have a series of modules that permit you to add as much as 96K of CMOS RAM or mix RAM and EPROM. The memory installs in place of the optional card reader.

Photo RAM Expansion Modules for the HP-71B.



FOR PC-1250/51/60/61 USERS

KEYBOARD AND DISPLAY I/O ON THE PC-1250

Rick Wenger, 6221 - 18th Avenue, Kenosha, WI 53140 is the provider of this article. He wishes to precede the article with the following disclaimer:

Although all routines presented here have been tested and run (sometimes for several days) on a PC-1250, there can be no guarantee that your PC-1250 will be the same. It is thus possible that you might do harm to your computer or connected peripherals by trying these routines. It is a healthy precaution, when experimenting with I/O, to be ready to use the RESET button at a moments notice.

In particular, you should be careful about sending output signals to a device at any rate faster than it is normally required to process. As an example, I once set up a loop to turn the display on and off as rapidly as possible. Upon execution, the top four rows of the left half of the display became extremely dark, while the rest of the display remained off. I quickly issued a RESET, but a "shadow" remained in the upper left-hand corner of the display for more than a week. If I had not reacted so quickly, I might well have lost some segments of the display.

Be careful! Apply the information contained herein at your own risk.

About the Keyboard

You can sense the keyboard from within machine language programs. The accompanying chart may be viewed as the electrical arrangement of the keyboard. As an example, if

604 is output through port C and 600 is output through port D, and an INA KBD instruction is invoked while the letter H key is pressed, the value 640 will be loaded into the CPU's accumulator. The following is a brief program, (in two parts, a BASIC portion and a machine language section) that will enable you to verify this information on your unit.

BASIC portion of the "key sense" program:

```
100 "KEY SENSE" INPUT "C? ";C,"D? ";D:POKE 6C2FE,C,D
110 CALL 6C300:PRINT "A=";PEEK 6C2FC:GOTO 100
```

Machine language portion of the "key sense" program:

MNEMONICS	COMMENTS	ADDRESS	MACHINE CODE
LDW C2FE	Load ports C	C300	10 C2 FE
LDP 5C	and D with	C303	12 5C
LD1(P)(W)	values from BASIC.	C305	1A
OUT C	Send	C306	5D
OUT D	strobe signals.	C307	DD
LOOP	INA KBD	C308	4C
CPA 00	key to be	C309	67 00
RZS LOOP	pressed.	C30B	39 04
LDW C2FC	Store contents	C30D	10 C2 FC
LD(W) A	of accumulator to	C310	52
RTS	(C2FC) & exit.	C311	37

Note that this "key sense" routine communicates with the user in decimal rather than hexadecimal. (All you really need to know is that 16d = 10h, 32d = 20h, 64d = 40h and 128d is equal to 80h.)

Once we know how to sense the keyboard, we can write a routine to return the character code of any key that is

Chart Port C and D Outputs When PC-1250 Keys Are Pressed.

	00-04	00-02	00-01	01-00	02-00	04-00	08-00	10-00	20-00	40-00
10	DEF	SHIFT	↑	↓	◀	▶				
20	Q	W	E	R	T	Y	U	I		
40	A	S	D	F	G	H	J	K	L	
80	Z	X	C	V	B	N	M	SPC	ENTER	O
02	8	9	CL	7						
08	5	6	/	4	P	O				
04	2	3	*	1	=					
01	.	+	-							

pressed. This is not necessary, however, since such a routine is already available in the ROM of the PC-1250. The routine that I call "KSCAN" begins at address 1F44. Chances are that a similar routine exists in the PC-1350 and other pocket computers that use the same kind of CPU chip. The character codes returned by this KSCAN routine are not in ASCII format. They are the codes shown in the accompanying table. (Most of these codes were originally published in Issue 26 of *PCW*.)

About the Display

The display memory of the PC-1250 is split into two parts. The left half of the display is controlled by bits in addresses F800 - F83B. The right half by bits in addresses F840 - F87B. The right half is ordered in reverse fashion to the left as far as memory addressing is concerned. See the accompanying diagram for a mapping illustration.

To facilitate discussion, I have numbered the columns of LCD dots from 1 to 120 decimal going from left to right. You can complete your understanding of the display using the simple (two-part) program provided next. The first portion of this routine is in BASIC:

```
200 "DISPLAY TEST" INPUT "ADDR? ";A
```

```
210 INPUT "BYTE? ";B
220 WAIT 0:PRINT "":POKE A,B:CALL 6C320:GOTO 200
The second part is in machine language:
```

MNEMONICS	COMMENTS	ADDRESS	MACHINE CODE
LDP 5F	Turn	C320	12 5F
LDA 01	on	C322	02 01
EXA (P)	the	C324	0B
OUTF	display.	C325	0F
SNOP	Do nothing	C326	40
SNOP	for a shot time.	C327	40
L1 IN 08	Wait for BRK	C328	68 08
RZSL1	key to be pressed.	C32A	39 03
L2 IN 08	Wait for BRK	C32C	68 08
RZCL2	key to release.	C32E	29 03
RTS	Exit to BASIC.	C330	37

To try this routine execute RUN 200. Enter a valid display address and a byte in the range 600 - 67F. Use the BRK key to exit the display loop. After you have tried several display addresses, you might want to see if you can modify the BASIC part of the program to allow input of the display column numbers instead of absolute addresses.

You may notice, when running this program, that the

Diagram Memory Map of the Display Bits for the PC-1250.

MID-POINT																																											
COLUMNS:	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0			
0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
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MEMORY	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F		
LOCATIONS:	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	0	1	2	3	4	5	

Table PC-1250 Character Codes.

00	Enter	43	3
02	CL	44	4
07	BRK	45	5
09	Shift	46	6
0A	DEF	47	7
0C	↑	48	8
0D	↓	49	9
0E	▶	4A	.
0F	◀	4B	␣
10	[(insertion)	4E	— (underscore)
11	Space	51	A
12	"	52	B
13	?	53	C
14	!	54	D
15	#	55	E
16	%	56	F
17	¥	57	G
18	\$	58	H
19	π	59	I
1A	√	5A	J
1B	,	5B	K
1C	;	5C	L
1D	:	5D	M
1E	@	5E	N
1F	&	5F	O
30	(	60	P
31	)	61	Q
32	>	62	R
33	<	63	S
34	=	64	T
35	+	65	U
36	-	66	V
37	*	67	W
38	/	68	X
39	^	69	Y
40	∅	6A	Z
41	1		
42	2	FF	no key

display is noticeably weaker than the one you normally see. This will be particularly so if you are using a weak set of batteries.

One way to perk up the display when running the routine is to insert a REFR nn instruction in the display loop. Change the machine language portion of the routine by doing the following: POKE 6C326,64E,6A0 and then POKE 6C32B,605. Try executing the program now. Do you like what you see? Can you figure out why the display dims when you press the BRK key?

Even this improved display did not satisfy the people who developed the ROM in the PC-1250. Make a few more pokes in the test routine as follows:

```
POKE 6C323,605
POKE 6C326,66B,601
POKE 6C32B,606
```

This will cause the machine language portion of the

display to be as follows:

MMEMONICS	COMMENTS	ADDRESS	MACHINE CODE
LDP 5F	Prepare	C320	12 5F
LDA 05	port F.	C322	02 05
EXA (P)	Turn slow	C324	0B
DISPL OUTF	display on.	C325	0F
IN 01	Super-slow mode.	C326	6B 01
IN 08	Stay in display	C328	6B 08
RZS DISPL	until BRK occurs.	C32A	39 06
L2 IN 08	Wait for BRK	C32C	6B 08
RZC L2	key to release.	C32E	29 03
RTS	Exit to BASIC.	C330	37

This routine puts the display loop into a "super-slow" mode that crawls along at just 7.4 loops per second. At this rate the display appears to wink about every half a second. If you replace the first IN 08 directive with a couple of SNOBs, you will see the phenomena disappear.

The display routine provided in the ROM alternates between using the "super-slow" mode and the REFR nn method of display maintenance. The method used depends on whether or not a key is being pressed.

Here are a few other useful ROM entry points that can be of use in handling the display:

At address 611A1 is a routine that dumps the contents of the display buffer (at addresses 6C7B0 - 6C7FF) to the display memory. It utilizes the character bit maps that are at addresses 64464 - 645DA.

At address 61D06 is a routine that maintains a nice display while scanning the keyboard. When a key is pressed, A is loaded with the appropriate code and control returns to the calling program.

The following short program can be used to fill the screen with the character specified by touching any key:

MMEMONICS	COMMENTS	ADDRESS	MACHINE CODE
LDW 66DA	Supress	C340	10 C6 DA
OR(W) 01	cursor	C343	05 01
LDA "SPC"	Use to clear bfr	C345	02 11
FILBF LDW 67B0	Fill buffer with	C347	10 C7 B0
LDC0 23	23 decimal (con-	C34A	00 17
LDO(W) A	tents of the acc.)	C34C	1F
DEA	If ENTER key is	C34D	43
FCG CONT	pressed, then	C34E	2A 02
RTS	exit this routine.	C350	37
CONT SS BTD	Call ROM routine	C351	F1 A1
SS DHOLD	Call ROM routine	C353	FD 06
REV FILBF	Loop back	C355	2D 0F

To start this routine, simply call 6C340. To exit, hit the ENTER key. Implementing SHIFT status will cause it to sustain until SHIFT is pressed a second time. Be careful though, some non-displaying shifted character can cause a crash. (Use the RESET button while depressing a key to recover from such a crash.)

If you want to do a little creative work on your own, why not see if you can write a program that allows the user to design a unique character and have it move around the display under control of the left/right cursor movement keys? Be sure to include provision for escaping from the program (without having to use the RESET button)!

Some Additional Information for Machine Language Buffs

The information in this section provides additional understanding of the PC-1250 from a machine language point of view.

The operation of the ON/RSV/PRO/RUN/OFF switch has been discussed previously. It is also important to realize that flipping this switch to the OFF position defeats the BRK key. Thus, if the computer is in a machine language loop and you flick this switch to OFF, the loop will keep repeating. But, the instruction IN 08 will no longer sense the BRK key (by clearing Z when BRK is pressed). If you subsequently turn the

switch back on, a brief BRK pulse will be sent out. This pulse can be recognized by an IN 08 instruction.

Pushing in the RESET button on the back of the PC-1250 interrupts normal sequential operations and restarts the CPU from address 0. Analysis of the start up routine indicates that the directive IN 40 checks for continued pressing of the RESET button. It does this by clearing the Z flag when RESET is closed (down). However, this is not possible to test experimentally.

A BRK pulse will also restart operations from address 0 when the CPU has been shut down by outputting 08 through port F. The CPA as well as RAM memory is preserved through power-down/power-up.

Once the RESET button is released, the PC-1250 has no apparent way of knowing whether start up was caused by the RESET button, cycling of the OFF/ON switch, or using BRK after automatic power-off. Thus, it appears to be the method of power-down that the PC-1250 flags (to itself) by leaving the CPA in various states, that determines whether the display comes back, whether program memory is preserved, and so forth. You can verify this by using the RESET button after an automatic power-off condition. There does not appear to be any need to hold down any other keys. Program, data and display are retained.

You might learn more about the methods of powering down

by studying the following ROM entry points:

61EA3 - automatic power-off routine.

64A57 - OFF switch power-down routine.

The Appendix in the PC-1250 Manual gives the following "last resort" RESET procedure: "Push the ALL RESET button in for about 10 seconds. This should clear any problem..." In fact, you can hold the RESET for 10 seconds or 10 minutes in some instances and it will have little effect. A better procedure is as follows. Makes sure the slide switch is set to the RUN position. Push the RESET button firmly and then release. Push the RESET button a second time and release. If this does not clear up any problems, then check your power source.

The regular high pitched BEEP sound can be generated by outputting the value 30 through port F. This produces a high concert B pitch. Sending the value 20 will provide a tone that is about an octave lower.

It is possible to create many other tones by tightening the beeper (10 out through port F) and slackening the beeper (00 out through port F) within a precisely timed program (machine language) loop.

The CPU is capable of sensing two different internal clock signals. IN 01 clears the Z flag approximately every half-a-second. IN 02 clears the Z flag approximately every two milliseconds.

FOR HEWLETT-PACKARD HP-71B USERS

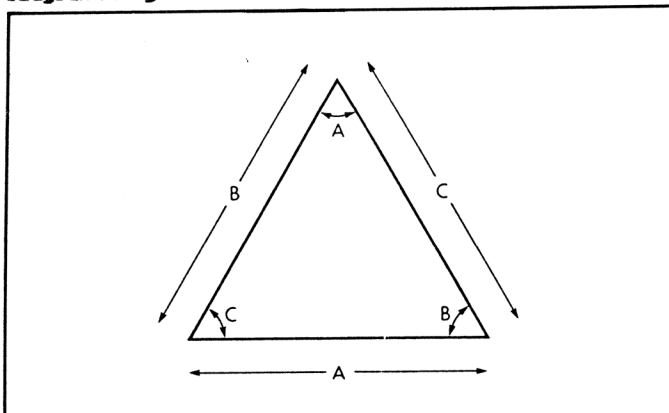
PROGRAM FOR SOLVING TRIANGULATION PROBLEMS

Surveyors and architectural engineers often need to find the solutions to problems involving triangles. This program can assist those dealing with such tasks. If you give it three parts of a triangle, including at least one side (see the accompanying diagram), it can generally find the remaining side(s) and angle(s).

Once the program has been loaded into your HP-71B, just respond to the prompts to utilize it. Unknown parts are designated by using the self-prompting value of zero. You can check that you keyed the program in correctly by verifying that the program has a byte count of 1319. Then confirm proper operation by executing the program using the inputs shown in the accompanying example. You should get the same output results.

This program was adapted for the HP-71B from a program originally submitted by *Norlin Rober*.

Diagram Designated Sides and Angles of a Triangle.



Example Operation of the Triangles Program.

```
SIDE A? 5
SIDE B? 0
SIDE C? 8
ANGLE A? 35
ANGLE B? 0
ANGLE C? 0
1st OF 2 SOLUTIONS:
SIDE A= 5.0000
SIDE B= 8.5393
SIDE C= 8.0000
ANGLE A= 35.0000
ANGLE B= 78.4047
ANGLE C= 66.5953
AREA= 19.5918
2nd SOLUTION:
SIDE A= 5.0000
SIDE B= 4.5671
SIDE C= 8.0000
ANGLE A= 35.0000
ANGLE B= 31.5953
ANGLE C= 113.4047
AREA= 10.4783
```

Program Solving Triangles on the HP-71B.

```

100 DELAY 8,.1 @ WIDTH 96 @ DESTROY ALL @ DEGREES @ FIX 4 @ DIM A(6)
110 INPUT "SIDE A? ", '0';A(1) @ IF A(1)=0 THEN 120 ELSE I=1
120 INPUT "SIDE B? ", '0';A(2) @ IF A(2)=0 THEN 130 ELSE I=I+2
130 INPUT "SIDE C? ", '0';A(3) @ IF A(3)=0 THEN 140 ELSE I=3-I
140 IF I=0 THEN 500
150 INPUT "ANGLE A? ", '0';A(4) @ IF A(4)=0 THEN 160 ELSE J=1
160 INPUT "ANGLE B? ", '0';A(5) @ IF A(5)=0 THEN 170 ELSE J=J+2
170 INPUT "ANGLE C? ", '0';A(6) @ IF A(6)=0 THEN 180 ELSE J=3-J
180 IF A(I)=0 THEN 300
200 L=90-A(4)-A(5)-A(6)+90 @ IF L<0 THEN 700
210 A(J+3)=L @ FOR K=1 TO 3 @ IF K<>I THEN A(K)=SIN(A(K+3))*A(I)/SIN(A(I+3))
220 NEXT K @ GOTO 600
300 IF J=I THEN 400
310 G=A(J) @ H=A(6-I-J) @ L=A(J+3) @ IF H*SIN(L)>G THEN 700
320 M=ASN(H*SIN(L)/G) @ A(9-I-J)=M @ IF L+M>=180 THEN 700
330 A(I+3)=180-L-M @ A(I)=G*SIN(L+M)/SIN(L)
340 IF G>H*SIN(L) AND H>G THEN PRINT "1st OF 2 SOLUTIONS:" @ N=1
350 GOTO 600
360 A(9-I-J)=180-M @ A(I+3)=M-L @ A(I)=G*SIN(M-L)/SIN(L) @ N=0
370 PRINT "2nd SOLUTION:" @ GOTO 600
400 L=A(I+3) @ FOR K=4 TO 6
410 IF K<>I+3 THEN G=A(K+3) @ H=A(9-I-K) @ A(K)=90
420 IF H<>G*COS(L) THEN A(K)=ATN(G*SIN(L)/(H-G*COS(L)))
430 IF -A(K) THEN A(K)=180+A(K)
440 NEXT K @ A(I)=SQR(G*G*SIN(L)*SIN(L)+(G*COS(L)-H)*(G*COS(L)-H)) @ GOTO 600
500 IF (A(1)+A(2)-A(3))*(A(1)+A(3)-A(2))*(A(2)+A(3)-A(1))<=0 THEN 700
510 A(4)=ACS((A(2)*A(2)+A(3)*A(3)-A(1)*A(1))/(2*A(2)*A(3)))
520 A(5)=ACS((A(1)*A(1)+A(3)*A(3)-A(2)*A(2))/(2*A(1)*A(3)))
530 A(6)=ACS((A(1)*A(1)+A(2)*A(2)-A(3)*A(3))/(2*A(1)*A(2)))
600 K=.5*A(1)*A(2)*SIN(A(6)) @ PRINT "SIDE A= ";A(1)
610 PRINT "SIDE B= ";A(2)
620 PRINT "SIDE C= ";A(3)
630 PRINT "ANGLE A= ";A(4)
640 PRINT "ANGLE B= ";A(5)
650 PRINT "ANGLE C= ";A(6)
660 PRINT "AREA= ";K
670 IF N THEN 360
680 END
700 PRINT "NO SOLUTION"

```

FOR PC-1500 & PC-2 USERS

BOWLING SCORE KEEPER

Here is a program that will take care of score keeping during a bowling game. When started, the program prompts for the number of players and their names. Use the main player menu thereafter to select a player whose score is to be updated. If you make a player selection error, enter a score greater than 10 to return to the menu. You need at least an 8K memory module and a printer/plotter to utilize this program.

The program was provided by *Robert Sincick, 9610 S.W. Davies Road, Beaverton, OR 97005.*

BOWLING

SUE	30	60	90	120	150	180	210	240	270	300	300
JOE	19	38	57	76	95	114	133	152	171	190	190
JIMMY	7	26	35	43	51	59	68	87	96	103	103
ROBERT	9	18	36	44	53	60	74	82	102	122	122
SAM	18	27	41	50	70	89	98	107	116	125	125
JANE	20	40	60	80	100	120	140	160	180	200	200

Program Bowling Score Keeper (PC-1500/PC-2).

```

1000 "BOWL"REM BOWLING SCORES GRAPHICS VERSION 6/13/84, BY BOB SINCICK
1005 "B"
1010 GRAPH :CLEAR
1020 "IN"INPUT "HOW MANY PLAYERS? ";N:IF N>6GOTO "IN"
1030 DIM N$(6):DIM P(6,14):DIM B(6,2):DIM W$(0)*26
1040 FOR X=1TO 6:FOR Y=11TO 12:P(X,Y)=1:NEXT Y:NEXT X
1050 FOR X=1TO 6:FOR Y=13TO 14:P(X,Y)=0:NEXT Y:NEXT X
1060 WAIT 0:FOR Z=1TO N:PRINT "PLAYER NO. ";(Z); " IS:";
1070 INPUT N$(Z):CLS :NEXT Z
1080 CSIZE 5:LPRINT "BOWLING":GLCURSOR (0,-150):SORGN :CSIZE 2
1090 FOR X=0TO 216STEP 72
1100 LINE (X,100)-(X,-410):LINE ((X+36),-410)-((X+36),100):NEXT X
1110 FOR Y=0TO -360STEP -72:LINE (0,Y)-(216,Y)
1120 IF ABS Y>=360GOTO 1140
1130 LINE (216,(Y-36))-(0,(Y-36))
1140 NEXT Y
1150 Z=1:FOR X=182TO 2STEP -36
1160 GLCURSOR (X,100):ROTATE 1:LPRINT USING "&&&&&&";N$(Z):Z=Z+1:NEXT X
1170 FOR Y=-36TO -360STEP -72:FOR X=18TO 198STEP 36
1180 LINE (X,Y)-(X,(Y+18))-((X+18),(Y+18)):NEXT X
1190 FOR X=216TO 36STEP -36
1200 LINE (X,(Y-18))-((X-18),(Y-18))-((X-18),(Y-36)):NEXT X:NEXT Y
1210 Y=-360:FOR X=18TO 198STEP 36
1220 LINE (X,Y)-(X,(Y-18))-((X+18),(Y-18))
1230 LINE (X,(Y-18))-((X-18),(Y-36))-((X+18),(Y-36)):NEXT X:GLCURSOR (0,0)
1240 W$(0)=" "+LEFT$ (N$(1),3)+" "+LEFT$ (N$(2),3)+" "+LEFT$ (N$(3),3)+" "
1250 W$(0)=W$(0)+LEFT$ (N$(4),3)+" "+LEFT$ (N$(5),3)+" "+LEFT$ (N$(6),3)
1260 CLS :USING :WAIT 0:PRINT W$(0);
1270 C$=INKEY$
1280 C=ASC (C$):IF (C<17)+(C>22)THEN GOTO 1270
1290 C=C-16:IF P(C,0)=1BEEP 4:GOTO 1260
1300 WAIT 00:CLS :PRINT N$(C); " F-";P(C,11); " BALL-";P(C,12); " ";
1310 INPUT B(C,(P(C,12)))
1320 IF P(C,12)=1LET B(C,2)=0
1330 IF (B(C,1)+B(C,2))>10OR (B(C,1)+B(C,2))<0BEEP 1:CLS :PAUSE "WRONG INPUT !"
GOTO 1260
1340 IF P(C,12)=1GOTO "FF"
1350 GOTO "PFST"
1360 "FF"IF P(C,11)=1GOTO "ST?"
1370 GOTO "PFSP"
1380 "PFSP"IF P(C,13)=1GOSUB "ACB":GOSUB "PLF":GOSUB "RSM":GOTO "ST?"
1390 GOTO "PPFST"
1400 "ACB"P(C,(P(C,11)-1))=P(C,(P(C,11)-2))+10+B(C,1):RETURN
1410 "RSM"P(C,13)=0:RETURN
1420 "ST?"IF B(C,1)=10GOSUB "SSM+1":GOSUB "PST":GOSUB "SBM1":GOTO 1260
1430 P(C,12)=2:GLCURSOR (0,-400):GOTO 1260
1440 "PFST"IF P(C,14)=1GOSUB "CF-1":GOSUB "PLF":GOSUB "SSM-1"
1450 GOTO "SP?"
1460 "SP?"IF B(C,1)+B(C,2)=10GOSUB "SSM":GOSUB "PSP":GOSUB "SBM1":GOTO 1260
1470 GOSUB "CF":GOSUB "PFS":GOSUB "SBM1":GOTO 1260
1480 "PPFST"IF P(C,14)=2GOSUB "CPPF":GOSUB "PPPF":GOSUB "SSM-1"
1490 GOTO "ST?"
1500 "PST"COLOR 1:Z=18:X=216-(((C-1)*36)+18):IF P(C,11)=1LET Z=36
1510 IF P(C,11)=12LET Z=54
1520 FOR Y=((-36*P(C,11)+Z))TO ((-36*P(C,11))+(Z-18))STEP -2
1530 LINE (X,Y)-((X+18),Y):LINE ((X+18),(Y-1))-((X,(Y-1)))
1540 NEXT Y:GLCURSOR (0,Y):RETURN
1550 "CF-1"P(C,(P(C,11)-1))=P(C,(P(C,11)-2))+B(C,1)+B(C,2)+10:RETURN
1560 "PLF"GLCURSOR ((217-(36*C)),(83-(36*P(C,11))))
1570 LPRINT USING "####";P(C,(P(C,11)-1)):IF P(C,11)-1=10GOSUB "LF"
1580 RETURN
1590 "CF"P(C,(P(C,11)))=P(C,(P(C,11)-1))+B(C,1)+B(C,2):RETURN
1600 "PFS"GLCURSOR ((217-(36*C)),(47-(36*P(C,11))))
1610 LPRINT USING "####";P(C,P(C,11)):IF P(C,11)=10GOSUB "LF"
1620 RETURN
1630 "SBM1"P(C,12)=1:P(C,11)=P(C,11)+1:GLCURSOR (0,-400):COLOR 0:RETURN
1640 "SSM+1"P(C,14)=P(C,14)+1:RETURN
1650 "SSM"P(C,13)=P(C,13)+1:RETURN
1660 "SSM-1"P(C,14)=P(C,14)-1:RETURN
1670 "PSP"COLOR 2:X=216-(((C-1)*36)+18)
1680 Y=((-36*P(C,11)+18)):Z=18:FOR G=1TO 18:LINE (X,Y)-((X+Z),(Y-18)):Z=Z-1
1690 LINE ((X+Z),(Y-18))-((X,(Y-18))):NEXT G:GLCURSOR (0,Y-18):COLOR 0:RETURN
1700 "CPPF"P(C,(P(C,11)-2))=P(C,(P(C,11)-2))+P(C,(P(C,11)-3))+20+B(C,1):RETURN

1710 "PPPF"GLCURSOR ((217-(36*C)),(119-(36*P(C,11))))
1720 LPRINT USING "####";P(C,(P(C,11)-2)):IF P(C,11)-2=10GOSUB "LF"
1730 GLCURSOR (0,(72-(36*P(C,11)))):RETURN
1740 "LF"COLOR 3:GLCURSOR ((217-(36*C)),-355):LPRINT USING "####";P(C,10)
1750 P(C,0)=1:GLCURSOR (0,-400):COLOR 0:RETURN

```

FOR PC-1350 USERS

DISPLAYING GRAPHS

Using this program, the Sharp PC-1350 can display the graph of an equation given in either rectangular or parametric form.

The equation to be graphed must be entered into the program, beginning at line 100. As an example (included in the accompanying program listing), to graph $Y = \sin X$, line 100 would be: 100 Y = SIN X.

Be sure the PC is set to the DEGREE mode. Then RUN the program. In response to the query "TYPE (R/P)?", enter R, since the equation to be graphed will use rectangular coordinates. Use 0 and 360 as values for MIN X and MAX X. For MIN Y and MAX Y use -1 and 1 respectively. (These inputs determine the portion of the plane that is to be included in the graph.) In response to the query "RATIO, W/H?", enter 2. This will make the width of the graph twice its height. (A ratio of 5 would widen the graph to fill the entire display.) The display will then plot a sine curve on the display, with the X- and Y- axes included.

The ellipse determined by the parametric equations expressed as $X = 2 \cos t$, $y = \sin t$ may be plotted by entering:

100 X = 2 * COS T

110 Y = SIN T

For this case, enter P in response to "TYPE R/P?". Enter MIN T and MAX T values of 0 and 360. Use 30 for "NO OF INCR" (the number of increments to be made to the value of T). Use -2 and 2 as minimum and maximum values of X. Use -1 and 1 as the values for Y. Specify a W/H ratio of 2. Observe the graph.

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Polar-coordinate graphs may be treated as parametric forms. To plot the three-leaf rose having the polar equation $r = \cos(\theta)$, consider T as the symbol for theta and enter the lines:

100 R = COS (3*T)

110 X = R * COS T, Y = R * SIN T

(Line 110 converts polar to rectangular coordinates for plotting.)

Set T minimum to 0, maximum to 360, with 90 increments. Set X to go from -1 to 1 and the same for Y. Use a W/L ratio of 1. Watch the graph plot on the screen.

You can experiment to your heart's content with various equations, using different numbers of increments, W/H ratios, and so forth. In many cases you will find that the limited resolution of the display prevents curves from being as smooth as one might desire. In spite of this, the PC-1350 and this program is able to supply an approximately accurate graph!

This program supplied by: *Norlin Rober, 407 North 1st Avenue, Marshalltown, IA 50158.*

Program Graphs on the Sharp PC-1350.

```

10: INPUT "TYPE (R/P)? "
   : G$
11: IF G$="P" INPUT "MIN
   : T? " : E, "MAX T? " : F
12: IF G$="P" INPUT "NO
   : OF INCR? " : N
13: INPUT "MIN X? " : A, "M
   : AX X? " : B
14: INPUT "MIN Y? " : C, "M
   : AX Y? " : D
15: INPUT "RATIO, W/H? "
   : L
20: K=30*L, HX=K/(B-A), VY
   =30/(D-C), HK=-A*HX+.
   5, VK=-D*VY+.5: CLS :
   WAIT 0
30: LINE (HK,0)-(HK,30):
   LINE (0,VK)-(K,VK)
40: IF G$="P" LET H=(F-E
   )/N, T=E: FOR I=0 TO
   N: GOSUB 100: T=T+H:
   NEXT I: WAIT :
   GPRINT : CLS : END
50: H=(B-A)/K, X=A: FOR I
   =0 TO K: GOSUB 100: X
   =X+H: NEXT I: WAIT :
   GPRINT : CLS : END
100: Y = SIN X
200: PSET (HX*X+HK, VY*Y+V
   K): RETURN
  
```